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SCIENCE

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SCIENCE

NEW YORK, MARCH 11, 1892.

THE SCIENTIFIC ALLIANCE.

THE Scientific Alliance of New York was organized in March, 1891. It consists at present in a union of six societies engaged in the promotion of scientific research. It is probable that this number will soon be increased to eight, and it is hoped that it may ultimately extend to at least ten. Membership in the Alliance is not confined to societies in New York City, but may include those in the neighborhood.

The societies now composing the Alliance,—naming them in the order of their foundation,—are as follows: 1. The New York Academy of Sciences, 2. The Torrey Botanical Club, 3. The New York Microscopical Society, 4. The Linnean Society of New York, 5. The New York Mineralogical Club, 6. The New York Mathematical Society.

The societies do not in any way sink their individuality or surrender any part of the management of their own affairs. Their union is merely in the way of co-operation for the advancement of science and for mutual encouragement, carried out through a central representative body, known as the Council, having advisory powers only. The Council is made up of the president, *ex-officio*, and two other delegates from each society.

A monthly bulletin is issued under the authority of the Council, announcing the proposed proceedings of all the societies, and a copy of this bulletin is sent to every member. The bulletin contains an invitation to the members to attend the meetings of all the societies.

The Council issues an annual directory, containing the names and addresses of all the resident members of the societies, as well as general information as to the character and purposes of the several organizations. It is proposed to issue also a brief annual report of the work done by the societies as a whole. The first directory published by the Council (that for 1891) contained 499 names. That for 1892 will contain a considerably larger number, as the membership of the societies has increased materially during the past year.

The New York Academy of Sciences was chartered as The Lyceum of Natural History, April 20, 1818. It was reorganized under its present name Feb. 21, 1876. It has a total membership of about 550, of which nearly one-half are resident members and fellows. It holds weekly meetings, on Monday evenings, from October to June. One evening of each month is devoted to a popular lecture. There are special sections of mineralogy and astronomy. Its place of meeting is now at Columbia College. The Academy publishes both Annals and Transactions. The Lyceum of Natural History was the owner of a building and a valuable scientific collection, which were destroyed by fire. The Academy possesses a library of between 10,000 and 12,000 volumes, which is being continually augmented by periodicals and Proceedings of kindred societies received in exchange for its own publications. This is an exceedingly important collection of scientific works, containing sets of the Proceedings of foreign bodies not to be found in any other library in New York, and in some cases not elsewhere in this country. At present the books are deposited in the library-building of Columbia College, but they may be withdrawn at any time.

The Torrey Botanical Club was incorporated April 21, 1871. It has a total membership of nearly 300, of which about one-half are resident members. It holds meetings twice a month, at Columbia College, and field-meetings every Saturday from April to November. It publishes a Bulletin and Memoirs. It has an herbarium of nearly 20,000 specimens. Its botanical library is incorporated with that of Columbia College. It consists of periodicals and Proceedings of other scientific societies, obtained by the exchange of publications, which are, for the most part, duplicated in the library of the Academy of Sciences.

The New York Microscopical Society was incorporated in 1877. It has a total membership of about 100, of whom some 75 are active members. Its meetings are held twice a month, at the Mott Memorial Library, No. 64 Madison Avenue. It publishes a quarterly journal. Its library consists of about 2,000 volumes, and is deposited at its place of meeting. It has also a collection of about 5,000 microscopical specimens.

The Linnean Society of New York was organized March 7, 1878. It has a membership of 85, of which about half are resident members. Its meetings are held twice a month, at the American Museum of Natural History. It publishes Transactions and an Abstract of Proceedings. It has a library consisting of exchanges from publications.

The New York Mineralogical Club was organized in 1887. It has a memberihip of about 60. It holds monthly meetings at various places. It owns the Chamberlain collection of New York Island minerals, which is deposited temporarily, with other strictly local minerals, in the American Museum of Natural History.

The New York Mathematical Society was organized Nov. 24, 1888. It has a membership of over 200, including almost every mathematician of note in America, and some residing abroad. Its local membership is about 35. It publishes a monthly Bulletin.

It will be seen from the foregoing summary that all of the societies included in the Alliance occupy only temporary quarters, and that their libraries and collections are widely scattered. It will be observed, however, that the latter are of sufficient size and importance to make a very creditable appearance if they could all be gathered in a single suitable place. It is confidently believed that the total amount of original scientific work brought out by the meetings of these societies is as great as that accomplished in any other city in America. Under proper conditions, however, the societies might not only become more helpful to one another, but might confer a greater benefit upon the community at large, by carrying on lines of work which they are now compelled to neglect from want of room and facilities. For example, all attempts at exciting popular interest in scientific subjects is now confined to a course of seven or eight lectures during the year, carried on by but one of the societies, when, in fact, if the Alliance were placed in possession of the necessary building and appliances, there is no reason why it

might not exert the same educational influence in New York as is put forth by the Royal Institution of Great Britain in London, in which a course of as many as eighty lectures of more or less popular interest has been given in a single season.

The brief experience which the Scientific Alliance has already had has convinced the members that a still closer union of the societies is necessary to the most effective accomplishment of their purpose, and this feeling has taken the form of an earnest movement for obtaining a permanent building as a home for all the societies. A building committee was appointed in October last, and has held several meetings and done much towards developing plans for the accomplishment of the object mentioned.

In the main these plans embrace the idea of the erection of a building, in the central part of the city, large enough to afford each society rooms for its ordinary meetings, for its library and collections, as well as facilities for research, and also to contain a lecture-hall, capable of seating twelve hundred people, to be used by all the societies in their public work. It is part of the aim of the Council to obtain, ultimately, if not at once, in connection with the proposed building, a fund for its maintenance and for the endowment of original research and publication.

It is hoped and believed that at this time, when public spirit appears to be undergoing a revival in New York, and numerous worthy objects are receiving generous aid and establishment by men of wealth, the cause of science will not be overlooked or neglected. Music and other fine arts and various charities have recently received munificent assistance in the very direction in which the Alliance is looking for aid,— namely, the erection of buildings suited to their particular needs,— and it seems reasonable to think that the man, or men, will soon be found with sufficient appreciation of scientific research, for both its educational and its practical value, to place it in a position as solid and substantial as that now likely to be occupied by the fine arts and by organized benevolence.

ACTINISM.

ON studying the nature of the action of the blue, or rather the violet, ray of the spectrum, it appears to me to be a misnomer to refer to it as chemical. The absorption of heat attends chemical decomposition, and on the other hand the disengagement of heat is the accompaniment of chemical combination. We read in Professor Wurtz's excellent treatise on "The Atomic Theory:" "It is heat which sets the atoms in motion; they have absorbed heat in separating from each other, since the rupture of the molecular equilibrium which marks the end of the state of combination has required the consumption of a certain quantity of heat. The heat thus absorbed has restored to the atoms the energy which they possessed before combination, and which represents affinity. This heat is lost again whenever the atoms, passing into the sphere of action of other atoms, fix the latter in some manner or are fixed by them so as to form new systems of equilibrium — that is, new molecules — in which henceforth their vibration and motion are preserved. This action is reciprocal." If with this we compare what takes place in the so-called chemical action of the violet ray, we find a great difference. The latter process is usually referred to as one of decomposition and not of combination, and, in fact, photography is based on the property possessed by light of decomposing chemical compounds by its reducing action.

It is true that this decomposition is supposed to be attended with certain chemical changes, as is the case also with the decomposition of amyl and other vapors in Dr. Tyndall's very interesting experiments in cloud making, although there appears to be some doubt as to the nature of the changes. Moreover, in the action of the violet ray on a mixture of chlorine and hydrogen gases the formation of hydrochloric acid would seem to be due to the operation of chemical affinity. Nevertheless, when we consider the analogy between this case and that of the formation of water by the passage of a current of electricity through a mixture of oxygen and hydrogen gases, a question may be raised as to whether the former is due to strictly chemical action. The phenomenon of electrolysis, in which the electric current decomposes a molecular compound, is, moreover, analogous to that of the decomposition of chemical compounds by the actinic action of the violet ray. The latter phenomenon answers to the decomposing action of heat, and the former to the combination of elements which attends chemical action; but they are not the same. This is evident from the fact that, while in the one case the combination precedes the discharge of heat on which decomposition depends, in the other case it follows decomposition.

Nevertheless, in all cases actinic action would seem to be attended with the aggregation of at least one element of the decomposed chemical compound. Thus, when on the exposure of chloride of silver to the action of light the chlorine is expelled, the silver is precipitated. The result depends on the instability of the equilibrium of chemical combination in the presence of certain light-rays, and it is thought that all substances are thus more or less affected by light. It is found that the red rays are chemically inactive, and of the others the absorbed rays are those which bring about the decomposition which is the basis of actinic action. The liquid nitrite of amyl allows the transmission of the yellow rays, and Dr. Tyndall states that the blue rays, as complementary to the yellow, are absorbed, and therefore that they produce the "chemical" effect. As a fact, however, the complementary of yellow is violet, and the greatest actinic action is in the violet ray, and it extends far beyond into the invisible rays. This in itself would seem to prove that actinism is not chemical action, as the intimate relation between this force and heat would lead us to expect the association of chemical action with rays towards the red end of the spectrum. The vibrations of heat are atomic and not molecular, and possibly this fact may have influenced Dr. Tyndall in his opinion that the absorption of the actinic rays occurs in the main within the molecule, and are not the act of the molecule as a whole. There is no reason, however, why the absorption should not be of the whole molecular mass; that is, of the body of molecules that make up the mass, just as the absorption of heat is that of the atoms which make up the molecule.

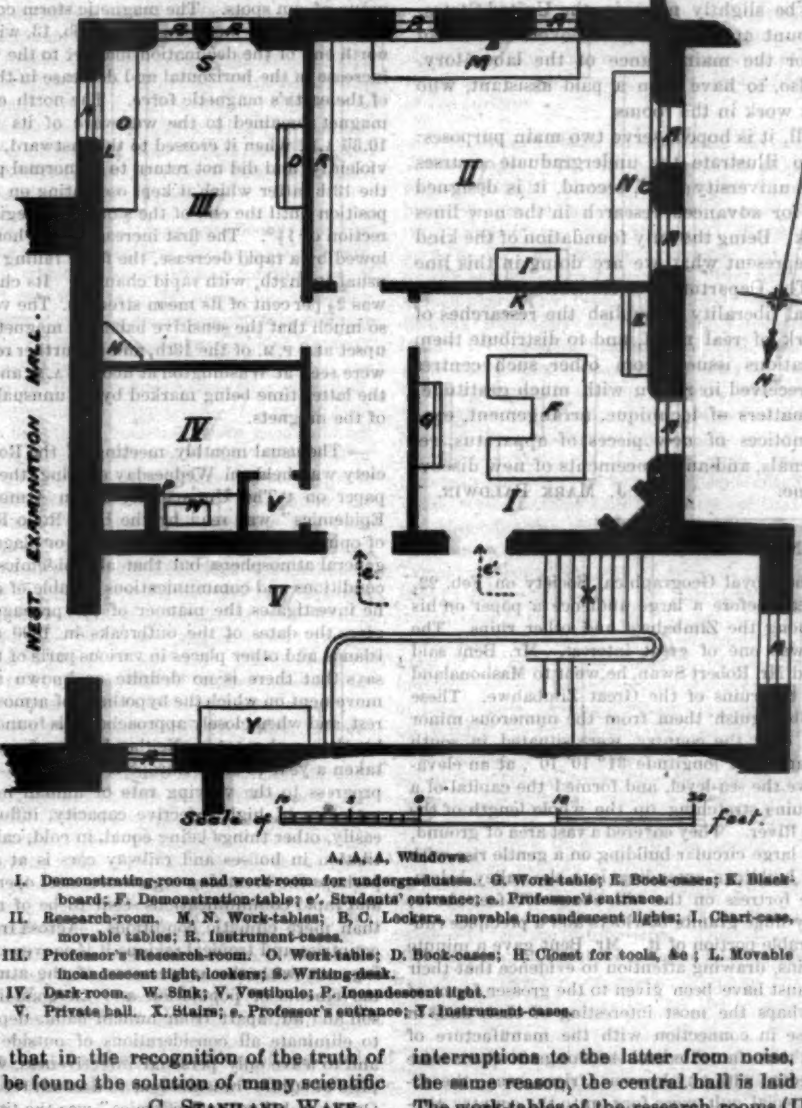
Here would seem to be the real explanation of the phenomena of actinism, which is a distinct power of light due to its activity as a molar energy, just as heat is an atomic energy. The combination which follows the decomposition effected by actinic action has a similar relation to chemical combination. The latter is atomic, whereas the former is molar, as it affects the mass, and this through its molecules and not through the atoms of which these are composed. From the fact that the electric light contains a large proportion of actinic rays, and that the electric spark in rarified air is diffused and of a violet color, it might be supposed that actinism is only a phase of electricity. That they are closely

related we may judge by what was said above, but there are reasons for believing them to differ from each other as they both differ from heat, although all alike are forms of energy. Actinic absorption, like coloric absorption, is attended with decomposition, but so far as the former is attended with or followed by an aggregation or combination of elements, as with chemical affinity, it is also a force, but molar rather than molecular or atomic. In distinguishing between these forms of matter, I adopt the principle laid down by Mr. Grant Allen, although not all the applications he makes of them, and I believe that in the recognition of the truth of those principles will be found the solution of many scientific problems.

C. STANILAND WAKE.

THE PSYCHOLOGICAL LABORATORY IN THE UNIVERSITY OF TORONTO.[1]

IN the spring of 1891 an appropriation of $1,100 was made for the equipment of a laboratory for experimental psychology at the instance of the writer. A suite of rooms, of which the accompanying cut gives the dimensions and arrangement, was set apart for the use of this department. The laboratory is located at the west end of the restored University College building on the first (not the ground) floor. It is isolated entirely from the general work of the building, being over the rooms of the physical department. The rooms have light exposure from three sides. The room which is used for students' demonstration and practical work (I. in the plan) is cut off from the research rooms, thus making interruptions to the latter from noise, etc., unlikely. For the same reason, the central hall is laid with cocoa matting. The work-tables of the research rooms (II. and III.) get light from the east, south, and west, a variety which is of great value, especially as the east exposure (Room III.) has reflected light from the walls of the main building (this is also partly the case with the light from the west windows, Rooms I. and II.). The rooms are artificially lighted by combination gas and electric chandeliers from the ceilings, and have besides movable incandescent lamps over the work-tables. The dark room is also furnished with incandescent lights. The floors throughout are carefully laid in hard wood. The



A, A, A, Windows.

I. Demonstrating-room and work-room for undergraduates. G. Work-table; E. Book-cases; K. Blackboard; F. Demonstration-table; e'. Students' entrance; e. Professor's entrance.

II. Research-room. M, N. Work-tables; B, C. Lockers, movable incandescent lights; I. Chart-case, movable tables; R. Instrument-cases.

III. Professor's Research-room. O. Work-table; D. Book-cases; H. Closet for tools, &c; L. Movable incandescent light, lockers; S. Writing-desk.

IV. Dark-room. W. Sink; V. Vestibule; P. Incandescent light.

V. Private hall. X. Stairs; e. Professor's entrance; Y. Instrument-cases.

[1] The accompanying plan is published at the suggestion of several psychologists who have borrowed and examined it; it is thought that the details may be of use to professors, boards, or trustees who are contemplating the providing of laboratories.

work-tables are braced diagonally from the walls by iron rods. The rooms are heated by steam radiators. The walls and ceilings are finished in dull white and the woodwork in dark walnut, colors being avoided in order to keep the physiological conditions of sight normal. Natural and colored light can be let into the dark room through the south wall. The central hall is lighted through glass panels in the doors.

The fittings of the laboratory have cost about $450 — a grant additional to the appropriation of $1,100 for instruments. This does not include, however, the arrangements for lighting, heating, and the special flooring. It is probable that the cost would be slightly more in the United States. Of the original amount appropriated, moreover, $300 is an annual allowance for the maintenance of the laboratory. The writer hopes, also, to have soon a paid assistant, who will be constantly at work in the rooms.

The laboratory will, it is hoped, serve two main purposes: First, it is used to illustrate the undergraduate courses in psychology in the university; and, second, it is designed to serve as a centre for advanced research in the new lines of experimental work. Being the only foundation of the kind in Canada,[1] it will represent what we are doing in this line in the Dominion. The Department of Education of Ontario undertakes with great liberality to publish the researches of students who do work of real merit, and to distribute them generously. Publications issued from other such centres everywhere will be received in return with much gratitude; and new ideas in matters of technique, arrangement, etc., especially detailed notices of new pieces of apparatus, reprints from the journals, and announcements of new discoveries, will be welcome. J. MARK BALDWIN.

NOTES AND NEWS.

AT a meeting of the Royal Geographical Society on Feb. 22, Mr. Theodore Bent read before a large audience a paper on his recent exploration among the Zimbabwe and other ruins. The paper, says *Nature*, was one of great interest. Mr. Bent said that, with his wife and Mr. Robert Swan, he went to Mashonaland primarily to examine the ruins of the Great Zimbabwe. These ruins, so named to distinguish them from the numerous minor Zimbabwes scattered over the country, were situated in south latitude 20° 16′ 30″, and east longitude 31° 10′ 10″, at an elevation of 3,300 feet above the sea-level, and formed the capital of a long series of such ruins stretching up the whole length of the west side of the Sabæ River. They covered a vast area of ground, and consisted of the large circular building on a gentle rise with a network of inferior buildings extending into the valley below, and the labyrinthine fortress on the hill, about 400 feet above, naturally protected by huge granite bowlders and a precipice running round a considerable portion of it. Mr. Bent gave a minute description of the ruins, drawing attention to evidence that their ancient inhabitants must have been given to the grosser forms of native worship. Perhaps the most interesting of their finds in one portion were those in connection with the manufacture of gold. Mr. Bent held that the ruins and the things in them were not in any way connected with any known African race; the objects of art and the special cult were foreign to the country altogether, where the only recognized form of religion was, and had been since the days when the early Portuguese explorers penetrated into it and El Masoudi wrote, that of ancestor worship. It was also obvious that the ruins formed a garrison for the protection of a gold-producing race in remote antiquity. So we must look around for such a race outside the limits of Africa, and it was in Arabia that we found the object of our search. All ancient authorities speak of Arabian gold in terms of extravagant praise. Little, if any, gold came from Arabia itself; and here in Africa gold was produced in large quantities, both from alluvial and from quartz, from the remotest ages. A cult practised in Arabia in early times was also practised here; hence there was little room for doubt that the builders and workers of the Great Zimbabwe came from the Arabian peninsula. He had no hesitation in assigning this enterprise to Arabian origin, and to a pre-Mahommedan period.

— The United States Hydrographic Office makes a report of the magnetic storm of Feb. 13-14, 1892, as recorded by the self-registering magnetic instruments of the United States Naval Observatory, Washington, D.C. These records of this unusually severe magnetic storm are of especial interest as occurring at the same time as the fine displays of auroræ and the appearance of a large group of sun spots. The magnetic storm commenced suddenly at 12.40 A.M. (75th meridian time), Feb. 13, with a movement of the north end of the declination magnet to the westward and a rapid increase in the horizontal and decrease in the vertical components of the earth's magnetic force. The north end of the declination magnet remained to the westward of its normal position until 10.30 A.M, when it crossed to the eastward, all the time oscillating violently, and did not return to its normal position until 8 P.M. of the 13th, after which it kept oscillating on each side of its mean position until the end of the storm. It registered a change of direction of 1½°. The first increase in the horizontal force was followed by a rapid decrease, the force falling to much less than its usual strength, with rapid changes. Its change during the storm was 2½ per cent of its mean strength. The vertical force decreased so much that the sensitive balanced magnet used to record it was upset at 8 P.M. of the 13th, and its further record lost. The auroræ were seen at Washington at about 2 A.M. and 7.30 P.M. of the 13th, the latter time being marked by an unusually disturbed condition of the magnets.

— The usual monthly meeting of the Royal Meteorological Society was held on Wednesday evening, the 17th of February. A paper on "The Untenability of an Atmospheric Hypothesis of Epidemics" was read by the Hon. Rollo Russell. The author is of opinion that no kind of epidemic or plague is conveyed by the general atmosphere, but that all epidemics are caused by human conditions and communications capable of control. In this paper he investigates the manner of the propagation of influenza, and gives the dates of the outbreaks in 1890 at a large number of islands and other places in various parts of the world. Mr. Russell says that there is no definite or known atmospheric quality or movement on which the hypothesis of atmospheric conveyance can rest, and when closely approached it is found to be no more available than a phantom. Neither lower nor upper currents have ever taken a year to cross Europe from east to west, or adjusted their progress to the varying rate of human intercourse. Like other maladies of high infective capacity, influenza has spread most easily, other things being equal, in cold, calm weather, when ventilation in houses and railway cars is at a minimum, and when perhaps the breathing organs are most open to attack. But large and rapid communications seem to be of much more importance than mere climatic conditions. Across frozen and snow-covered countries and tropical regions it is conveyed at a speed corresponding, not with the movements of the atmosphere, but with the movements of population and merchandise. Its indifference to soil and air, apart from human habits depending on these, seems to eliminate all considerations of outside natural surroundings, and to leave only personal infectiveness, with all which this implies of subtle transmission, to account for its propagation. "The Origin of Influenza Epidemics" was the title of a paper by Mr. H. Harries. The author has made an investigation into the facts connected with the great eruption of Krakatoa in 1883, and the atmospheric phenomena which were the direct outcome of that catastrophe. He has come to the conclusion that the dust derived from the interior of the earth may be considered the principal factor concerned in the propagation of the recent influenza epidemics, and that, as this volcanic dust invaded the lower levels of the atmosphere, so a peculiar form of sickness assailed man and beast. A "Report on the Phenological Observations for 1891" was made by Mr. E. Hawley. This report differs in many respects

[1] The first in the British Dominion as far as my information goes.

from the previous reports on the same subject. Among other changes, the number of plants, etc., selected for observation has been greatly reduced, while the number of observers has considerably increased. The winter of 1890–91 proved in England very destructive to the root crops, as well as to green vegetables and tender shrubs. Birds also suffered severely. In Scotland and Ireland, however, there was scarcely any severe weather until March. The flowering of wild plants was greatly retarded by cold in the spring, but during the summer the departures from the average were not so great. The harvest was late and its ingathering much interfered with by stormy weather.

— Recent experiments by Messrs. W. Thomson and F. Lewis on the action of metals on india-rubber, according to *Engineering*, show that that of copper is the most deleterious. Platinum, palladium, aluminium, and lead act only very slightly, while magnesium, zinc, cadmium, cobalt, nickel, iron, chromium, tin, arsenic, antimony, bismuth, silver and gold have no action whatever on this material. Of metallic salts, those of copper are very destructive, but nitrate of silver, manganese oxide, and several less common salts are equally so. The nitrates of iron, sodium, uranium, and ammonia have also a deleterious action, though less pronounced than in the case of the salts previously mentioned.

— At the anniversary of the British Geological Society, held on the 19th of February, the retiring president, Sir Archibald Geikie, gave the annual address, which was devoted to a continuation of the subject treated of by him last year. He now dealt, according to *Nature*, with the history of volcanic action in this country from the close of the Silurian period up to older Tertiary time. The remarkable volcanic outbursts that took place in the great lakes of the Lower Old Red Sandstone were first described. From different vents over central Scotland, piles of lava and tuff, much thicker than the height of Vesuvius, were accumulated, and their remains now form the most conspicuous hill-ranges of that district. It was shown how the subterranean activity gradually lessened and died out, with only a slight revival in the far north during the time of the Upper Old Red Sandstone, and how it broke out again with great vigor at the beginning of the Carboniferous period. Sir Archibald pointed out that the Carboniferous volcanoes belonged to two distinct types and two separate epochs of eruption. The earlier series produced extensive submarine lava-sheets, the remains of which now rise as broad terraced plateaux over parts of the lowlands of Scotland. The later series manifested itself chiefly in the formation of numerous cones of ashes, like the *puys* of Auvergne, which were dotted over the lagoons and shallow seas in central Scotland, Derbyshire, Devonshire, and the south-west of Ireland. After a long quiescence, volcanic action once more reappeared in the Permian period; and numerous small vents were opened in Fife and Ayrshire, and far to the south in Devonshire. With these eruptions the long record of Palæozoic volcanic activity closed. No trace has yet been discovered of any volcanic rocks intercalated among the Secondary formations of this country, so that the whole of the vast interval of the Mesozoic period was a prolonged time of quiescence at last when the soft clays and sands of the Lower Tertiary deposits of the south-east of England began to be laid down, a stupendous series of fissures was opened across the greater part of Scotland, the north of England, and the north of Ireland. Into these fissures lava rose, forming a notable system of parallel dykes. Along the great hollow from Antrim northwards between the outer Hebrides and the mainland of Scotland, the lava flowed out at the surface and formed the well-known basaltic plateaux of that region. The address concluded with a summary of the more important facts in British volcanic history bearing on the investigation of the nature of volcanic action. Among these Sir Archibald laid special stress on the evidence for volcanic periods, during each of which there was a gradual change of the internal magma from a basic to an acid condition, and he pointed out how this cycle had been repeated again and again even within the same limited area of eruption. In conclusion, he dwelt on the segregation of minerals in large eruptive masses, and indicated the importance of this fact in the investigation, not only of the constitution and changes of the volcanic magma, but also of the ancient gneisses where what appear to be original structures have not yet been effaced.

— Dr. L. Swift of Rochester, N.Y., discovered a bright comet on the morning of March 6. The object is in R.A. 18 h. 59 m., Dec. south 31° 20'. It is moving easterly.

— As bearing on the vital question of the exhaustion of the coal resources of Belgium *Engineering* states that, while the average depth of the French coal mines is 1,056 feet, the average depth in Hainaut is 1,773 feet; that in the Mons Basin there is a pit now being worked of 2,988 feet in depth, and another unworked pit in the same district of 3,801 feet; while in April last it was reported that in a Borinage pit, known as "Sainte Henriette des produits," at Flénu, a rich seam of coal had been discovered at the extraordinary depth of 4,120 feet. These figures tend to show that Belgium is rapidly exhausting the "cream of the coal resources" of the country — that is, coal found within 2,000 feet of the surface.

— A. Coppen Jones, writing from Davos Platz, Switzerland, to *Nature*, says: "In 1889 a French naval surgeon, M. Ledantec, published in the *Annales de l'Institut Pasteur* the result of some investigations he had made into the nature of the arrow poison of the natives of the New Hebrides. Wounds from these arrows give rise, as is well known, to tetanus, and M. Ledantec was able, by the subcutaneous injection of the scraped off poison, to kill guinea-pigs under typical tetanic symptoms. He learnt from a Kanaka that they are prepared by smearing the arrow-heads (which are made of human bone) first with tree gum and then with mud from a swamp, which mud he found to contain numbers of Nicolaier's tetanus bacillus. As far as I am aware, this has been recorded only of the natives of the New Hebrides and some of the neighboring groups (the arrow poison of Stanley's dwarfs is certainly *not* the same), and I was therefore much interested some days ago by coming accidentally upon an old record which seems to show that the natives of the Cape Verd coast were accustomed, more than three hundred years ago, to get rid of their enemies in a similar manner. In Hakluyt's "Voyager's Tales," published in 1589 (I refer to the little reprint edited in 1889 by Henry Morley), is the narrative of one Miles Phillips, in which occurs the following passage: 'Upon the 18th day of the same month (November, 1567) we came to an anchor upon the coast of Africa at Cape Verde, in twelve fathoms of water, and here our General landed certain of our men, to the number of 160 or thereabouts, seeking to take some negroes. And they, going up into the country for the space of six miles, were encountered with a great number of negroes, who with their envenomed arrows did hurt a great number of our men, so that they were enforced to retire to the ships, in which contest they recovered but a few negroes; and of these our men which were hurt with their envenomed arrows, there died to the number of seven or eight in a very strange manner, with their mouths shut, so that we were forced to put sticks and other things into their mouths to keep them open.' In the language of modern medicine, they succumbed to tetanus traumaticus. The voyagers left the coast soon after, and there is no further mention of the natives or of the wounded. There is, of course, no proof that the arrows were poisoned with mud or earth, but the probability is considerable. The chief interest lies in the age of the record, which forms in some manner a pendant to the researches of M. Bossano (*Comptes rendus*, 1888), which showed the tetanus bacillus to have a very wide distribution in space. It is a curious consideration that this and the other famous arrow poison, curare, both kill by their action on the voluntary muscles, the action of one being diametrically opposed to that of the other."

— The *Electrical Review*, New York, the first electrical weekly published in this country, issued a decennial number dated Feb. 20, 1892, in commemoration of its tenth birthday. The past decade of electrical progress is presented, and what may be expected in the future of this science is outlined. Articles specially contributed to this issue by leading electrical workers appear, with many portraits of interest.

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For Advertising Rates apply to HENRY F. TAYLOR, 47 Lafayette Place, New York.

CURRENT NOTES ON ANTHROPOLOGY.—I.

[*Edited by D. G. Brinton, M.D., LL.D.*]

Evolution of the Human Skull.

DR. PAUL TOPINARD of Paris, whose studies in physical anthropology place him in the front ranks of that science, has summed up in a recent number of *L'Anthropologie* the results of several years' investigations concerning the transformation of the animal into the human skull. He demonstrates that this change is brought about by the gradual development of the brain, and the resulting mechanical pressure on the hard parts adjacent. The pressure exerted by the enlarging hemispheres on the occipital bone is in a direction backwards and downwards, so that what is its superior surface in ordinary mammals becomes the posterior in man, and its posterior face the inferior. The occipital foramen, instead of looking backwards, is in man turned downwards. The increase in size of the anterior lobes of the hemispheres brings about still greater changes in that portion of the cranium. The orbits are pressed from a lateral into a frontal position, the face, instead of being in front and oblique, becomes vertical, and below the frontal lobes; and numerous minor alterations in the anatomy of the parts are necessitated by these changes. It is easy to arrange a perfectly graduated series of skulls illustrating this development from the lowest mammals up to man. Next to him are the monkeys, below these the lemures, and then follow the inferior mammals. Everywhere the principle of harmonic accommodation of organ to function is strikingly shown. Although the general statement of this evolution has been frequently advanced, it has never before received so complete a demonstration.

Physical Types in the Natives of South America.

The effort has repeatedly been made to subdivide the native tribes of South America on purely physical characters. It was attempted more than fifty years ago by Alcide D'Orbigny, in his "L'Homme Americain;" but his plan has not proved satisfactory. The latest scheme is that of Dr. Deniker, who accompanied the French scientific expedition to Cape Horn. He measured some eighty odd Yahgans, a tribe who live on the southern shore of Tierra del Fuego. He found them of short stature, head large and mesocephalic, prominent superciliary ridges and malar bones, forehead narrow, low, and retreating, eyes small and horizontal, orbits medium, mouth large, lips thick, slight prognathism. On the strength of these measurements, Dr. Deniker has urged in various scientific publications that we find in the Yahgans a "race" quite different from the Patagonians and allied to the Botocudos, the Coroados, and the Aymaras, as well as to the ancient Lagoa Santa peoples. This grouping, allowing that it is anatomically accurate, serves to illustrate how useless is an ethnographic classification based on small anatomical points. The Aymaras, Botocudos and Yahgans are as far apart in language, culture and character as any tribes which could be selected in South America. Moreover, the Botucudos differ widely among themselves is physical aspects, as Dr. Paul Ehrenreich has abundantly shown. In fine, it is high time to dismiss the anatomical subdivisions of the American race, and rely on language as, after all, when prudently employed, our best guide.

Deniker's theories will probably attract the more attention by being brought into relation with the interesting recent discoveries by Florentino Ameghino in the eocene beds of Patagonia. This eminent geologist has described, in a late number of the *Revista Argentina de Historia Natural*, the remains of four species of monkeys from what he believes to be the lower eocene — which would place them far more remote than any found in Eurasia, the oldest there exhumed being from the middle miocene. Ameghino therefore claims Patagonia as the cradle af the first Primates and of the immediate precursors of Man. Nor does he hesitate in this connection to add that in his opinion the very oldest relics of man's activity have been found in the same district.

We must, however, temper this enthusiasm by some hesitancies. When Ameghino assigns these beds to the lower eocene, he does so entirely on palæontologic grounds. The more cautious geologists are getting to rely less and less on these, and to demand more and more stratigraphic testimony. This is alone convincing. The native fauna of Australia to-day is much older in type than that of Eurasia; and similar instances no doubt existed in all ages of the world's history. Moreover, the remains which Ameghino describes are strictly American in type. His *Anthropops perfectus*, although it had its teeth disposed in a semicircle, as in man, had nevertheless thirty-six teeth, as had all the American monkeys, both recent and fossil. His *Homunculus Patagonicus* was yet more Lemurian in type. The evidence is far from adequate, therefore, to substantiate the daring inductions which Ameghino draws from these finds.

The Question of the Celts.

The latest contribution to the vexed question of the ethnographic position of the Celts is from the pen of the veteran anthropologist of Bonn, Professor Schaaffhausen. It is published in the *Festschrift zum Fünfzigjährigen Jubiläum des Vereins von Alterthumsfreunden im Rheinlande*. It includes a careful review of the classical authorities on the Celts and Gauls; in which one is surprised to find a denial that the bands who overran Italy in 393 B.C. were Celtic. Surely the title of their chiefs, *brennus*, "king," is evidence enough that they spoke a Celtic dialect. The professor is also sadly out in attributing the North African blonds to immigration from Europe. The blood type is essentially

that of the Hamitic Berbers who have lived in the vales of the Atlas from the remotest times. In attributing the megalithic monuments of western Europe and northern Africa exclusively to Celtic and Germanic peoples, he proceeds beyond what archæologists have conceded. The difficult problem of the conflicting physical types among the Celtic nations — the one short in stature, brachycephalic, and brown, the other tall, dolichocephalic, and blond — he summarily solves by supposing either an intermixture with other types or a change in mode of life and climatic environment. The Celtic language he places, as do now all leading linguists, within the Aryan group and in that category most closely allied to the Italic stock.

The same topic is discussed very ably by the French anthropologist, Dr. R. Collignon, in one of the recent bulletins of the Société d'Anthropologie. After setting forth in strong lights the embarrassing nature of the evidence, he finally leans to Broca's opinion, that the small, brown, brachycephalic Celts are a mixed type; while the true and primitive type, which we may call the Kymric, was one of tall stature, with reddish or blond hair and dolichocephalic crania. An interesting portion of Dr. Collignon's memoir is where he points out the persistency of various physical types in portions of France for many centuries, even for thousands of years, as an examination of ancient sepulchres has proved.

MOTION AND HEAT.

[Continued from p. 135.]

BUT nature has other means of compensation for the molar motion converted into heat. Incalculable units of heat-energy are stored up in vegetable and animal organisms; and in evaporation still more countless units of heat-energy are converted first into molecular, and then into molar motion, in its most terrific forms.

Evaporation and the function it performs in the economy of nature are as yet little understood. It appears to be a form of expansion, and, like expansion, it increases with elevation of temperature; but it does not stop when expansion ceases, for it is well known that ice continues to evaporate below zero C.

It is undoubtedly the great instrumentality for converting heat into motion. It is constantly acting, and in the trade wind region eleven feet of the ocean's depth is annually lifted up and carried off by this silent process. Molecule by molecule the aqueous vapor is torn from the liquid mass, each one carrying or embodying so much heat and thus reducing temperature; in other words, each molecule moved in evaporation furnishes work in the form of motion for so much of the force or energy which was dynamic in the form of heat.

Molecular motion, evidenced by gaseous expansion in a closed vessel, is governed by the general laws of motion;[1] and it seems incredible and anomalous to hold that the inert molecule moved in evaporation, which unites with its fellows as aqueous vapor, and comes down again as rain, is not governed by the same laws of the motion which this force or energy, in the form of heat, imparts to it in the atmosphere.

If these laws of motion do apply to the motion imparted by converted heat to evaporated molecules, we have an origin for the trade winds far more simple than the generally supposed convection. The trade winds blow over the tropical water where convection is smallest, and not over tropical land, where it is greatest.

But it is sufficient for the present purpose to show that heat is converted into motion in the process of evaporation; and that even if the force or energy which, in the form of molar motion, is directly converted into heat by resistance, cannot be directly reconverted from heat into molar motion, there is in terrestrial nature a law of compensation which tends to convert any surplus of dynamic heat into dynamic motion, and thus preserve the equilibrium which has been observed.

Professor Tyndall has taught us how to trace radiant energy from one body to another, and how the dark or heat rays may be concentrated into the more intense light rays, after they have left the body which sent them forth. And Faraday, Joule, Mayer, Grove, and others have taught us the law of conservation, by which we know that this energy, when it disappears, is not annihilated, and when it reappears it is not a new creation. We see its manifestation in motion, molar and molecular; we feel it in heat, we see it in light and color, and hear it in sound. The motion may cease; light may be extinguished in darkness; colors may fade, and sound give place to profound silence; but the energy or force which caused all these phenomena was the same before they appeared as during their continuance, and its potential existence remains after their disappearance with the same measurable units as when it was dynamic, and subject to observation.

When the demon was cast out of the man and went into the swine, and they ran into the sea, it was the swine, and not the demon, who were drowned. He doubtless passed out into demon land, ready to again become dynamic when occasion offers.

This force, or energy, we are trying to trace, while dynamic, can only do so much work at one time. If it is entirely occupied in moving a mass, it cannot do other mechanical work; and if entirely occupied in molecular motion it cannot elevate temperature, nor become radiant as heat or light. And when rendered entirely potential, as when a ball thrown up is lodged on the roof of a house, or when heat becomes latent in liquefaction or evaporation, or when the sun's energy is locked up in the molecular structure of vegetable and animal organisms, it can do no work at all until again rendered dynamic. Its power and capacity when released is identically the same, neither more nor less, than when it was locked up. This is true whether it was locked up as motion or locked up as heat.

It has always seemed to me to be unfortunate and misleading that Professor Tyndall should have adopted "Heat a Mode of Motion" as the title of the book in which he gives to the world an account of his great and valuable researches in the delimitation of this force. Like the term "Mechanical Equivalent of Heat," it results from mistaking the thing done for the thing doing it, the effect for the cause. Heat is not a mode of motion, and it would be just as inaccurate to call gravity a mode of weight, or magnetism a mode of pull, and even less inaccurate to call motion a mode of heat. Motion and heat are forms or manifestations of the same force or energy, and when radiant, as heat and light, it is more nearly disconnected from ponderable matter than when it assumes the form of molar or molecular motion.

Motion, in all its forms, is the transference of material substance, ponderable or imponderable matter, from one place or part of space to another; it is the state of ponderable matter in which the forces acting on it are not in equi-

[1] "Molecular Motion in the Radiometer," etc., p. 16.

librium. *Rest* is the opposite of motion; it is the state of matter in which the physical forces acting on it are in equilibrium; that is when the force impelling motion in a given direction is counteracted by an equivalent force impelling motion in the opposite direction; or is resisted by a superior force. A stone *rests* on the surface of the earth because the force of gravity acting on the stone is resisted by the force of cohesion in solid matter; but the force continues although there is no motion resulting from it. The stone *sinks* in water, that is, it moves from the force of gravitation because the force of cohesion in the molecules of water is insufficient to counteract the force impelling motion; but when the force of cohesion in the molecules is sufficiently increased by congellation, the stone *rests* on the surface of the ice. So a top spun rapidly *rests* on its peg, because the force giving it horizontal motion counteracts the pull of gravity which causes it to fall when the rotation ceases.

Dr. Mayer defines force as "Something which is expended in producing motion; and this something which is expended is to be looked upon as a cause equivalent to the effect, namely to the motion produced."[1]

This is obviously too narrow to include even dynamic energy. Two horses pulling a vehicle in opposite directions with the same force would produce no motion; divide the force by unhitching one of the horses, and the vehicle moves. Then, according to this definition, we have the absurdity that the whole force is nothing, but half of it is something.

A correct definition of physical force is that it is something producing the state of ponderable matter in which it is subject to human observation. Whether the state be one of motion or rest, hot or cold, solid, liquid, gaseous, colored, etc., it is the result of force. We only know physical force from its effects on ponderable matter, and we only know ponderable matter as affected by force.

The supposed difficulty in the concept of an element in nature entirely distinct from, but inseparably connected with, ponderable matter, is entirely factitious. Time and space are such elements, entirely distinct from, and inseparably related to, ponderable matter; and the concept of force as above defined is as absolute and imperative as the concept of time, the concept of space, or the concept of matter itself. The progress of science in tracing a force through its various manifestations, as has been done to some extent with gravity, confirms the primal concept of force which comes with the very dawn of intelligence.

The still more abstract concept of law by which any force is what it is, is also primal, absolute, and inevitable in every human intelligence.

Whether all ponderable matter is one as claimed by some philosophers, or whether all force is one as claimed by other philosophers, are speculations which, with our present knowledge of these elements, are idle if not mischievous.

It is undoubtedly from phenomena resulting from the apparent differences in ponderable matter, and the apparent differences in the forces acting on it, that real progress in unravelling nature has been made.

We need a specific name for this force of which molar motion, molecular motion, heat, and light, are manifestations. There seems to be no doubt that positive electricity is also one of its forms. Electricity, like heat, is developed by friction and by chemical reaction; and its mechanical equivalent, or, more accurately, the electric equivalent of molar motion, doubtless is the same as the heat equivalent of molar motion, or differs from it by some law which will prove the identity of the force. Dr. Mayer suggested that whether friction, which of course is resisted molar motion, developed heat or electricity, depended on the character of the substances used in the friction, homogeneous substances developing heat and heterogeneous substances electricity. There appears to be no essential difference in the chemical reactions which develop heat and those which develop electricity; the difference apparently being in the mode of applying the force or energy and the substances to which it is applied.

Electricity passes from dynamic to potential under not precisely the same conditions as heat, but not more essentially different than the conditions under which motion passes from dynamic to potential, and its dynamic power is exhausted in doing work. This feature of electrical energy has been utilized by Mr. Hodges in his new lightning-rod, constructed of copper ribbon, so arranged that the copper will be dissipated by the electric current.

But I must leave this branch of the subject to those better informed as to the phenomena.

There may be still other forces, or rather forms of force, which may be found to have equivalence and mutual convertibility with heat. It is equivalence and mutual convertibility which warrants the assumption that motion and heat are phenomena resulting from, or, more accurately, are manifestations of, the same force.

In speaking of the force itself, I have used the expression "force or energy" because these words have several meanings, and the sense in which they are synonymous comes nearer the expression of the concept sought to be presented than any other phrase that has occurred to me. But it would facilitate induction if we could call it "Ergic Force," or "Ergism," or give it some other specific designation to distinguish it from other forces, or force generally, including under the term "Ergism" every manifestation of force for which a heat equivalent may be found. This name seems appropriate because it suggests the element in nature which is the basis of work. It enables us to grasp a concept of the force distinct from its manifestation in any one of its forms; and if the delimitation itself is correct we can class as "Antergic" the forces, like cohesion, which have no heat equivalent, but which, under certain conditions, render dynamic "Ergism" potential. DANIEL S. TROY.

[1] "Correlation and Conservation of Forces," D. Appleton & Co., 1890, p. 133.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Further Notes on the Loup and Platte Rivers.

SEVERAL years since it was my privilege to spend several weeks studying the peculiar drainage of central Nebraska. I have therefore been much interested in the papers of Professors Hicks and Davis in recent numbers of *Science*. I trust I shall not be intruding if I call attention, at this time, to a few additional facts which seem to have a bearing on the discussion.

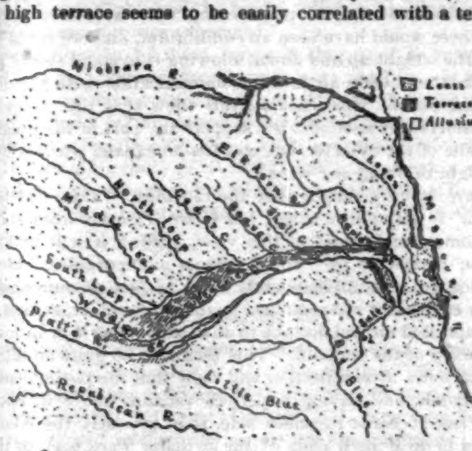
1. The streams north of the Platte, from Kearney to Fremont, have their courses first quite regularly south-east, then, as they near the Platte, they turn to the east-north-east, adopting the direction of that stream. Not only is this true of the Loup system, as Professor Hicks has well shown, but also of Shell Creek and Maple Creek further east.

2. There are dry channels, but little above the streams, connecting the Loup with Shell Creek, and Shell Creek with the Maple, which are known as Lost Creek and Dry Creek. These lie in the

same east-north-east direction, and are clearly analogous with the lower course of the Loup, where it connects its various branches. It seems not very improbable that the channel mentioned by Professor Hicks as connecting the South Loup with Wood River may be of the same sort.

3. The hills north of this compound channel, as it might be called, running parallel with the Platte, are of similar height and structure to those south of the Platte, but the hills south of the same channel are more than 100 feet lower, and of different structure. Both are capped with yellow loam of almost the same texture, but underneath the former have a well defined stratum of northern drift east of the meridian of Columbus, while the latter have but a faint trace of it mixed with deep stratified sand. These lower hills, moreover, are less eroded, and are evidently an alluvian terrace formed since the deposition of the older drift and the Loess. This terrace is seventy to ninety feet above the Platte, east of Columbus, and is more sandy and lower further west. The ancient north bank approaches the present Platte again, near Josselyn.

4. Corresponding in level to this high terrace, is an old channel crossing Saunders County along the valley of Sand Creek and in direct line with the upper course of the Maple. East of this is an area of higher land between it and the Platte, which has been recognized as an "ancient island." It may be added, also, that this high terrace seems to be easily correlated with a terrace of



Drainage Map of Eastern Nebraska.

similar height and structure, found at several points along the Missouri, which may be referred either to the "Second Glacial Epoch" or to the time of the second cluster of moraines of that epoch.

The subjoined map exhibits most of the points mentioned above, as well as some knowledge of the drainage, and indirectly of the topography of the surrounding region.

These facts point strongly to the efficiency of the second influence mentioned by Professor Hicks, viz., "Pliocene channel filling," as the principal and sufficient reason for the peculiar arrangement of the Loup channels, rather than a secondary influence. This has been already pointed out by Professor Davis. The Loups did formerly flow through to the Platte, but at a time when it or a portion of it occupied the north channel already described, and when it was flowing on a level seventy-five to a hundred feet higher, relatively, than at present, somewhat as it now occupies the channel north of Grand Island, and probably not long ago occupied a portion of Prairie Creek. The superabundant sediment, the shifting of the Platte to the south in obedience to Ferrel's law,— possibly reinforced by a tipping to the south, — and a deepening of its channel, which may have been partly due to a cutting through of a divide north of the "ancient island" into the lower channel of the Elkhorn, which, again, may have been accelerated by the recent eastward tipping of the region, are sufficient causes to explain the changes of the Platte, Loup, and associated streams since the disappearance of the waters which deposited the loess. The exceptional course of the Platte, however, from Kearney to Fremont, which we conceive was first taken about that time, remains unexplained. The causes which may be surmised are the following: 1. The position of a depression in the bottom of the Pliocene or Pleistocene lake, which may in some way have been produced by unequal deposition of its sediment, or the earlier unequal erosion or deposition of the subjacent formations whose strike here is approximately north-east. 2. A slight fold in the plains a little south of this course of the Platte. Of such no distinct trace has yet been found. There is a slight anticlinal axis crossing the Big Blue near Milford, but it is probably quite limited in extent. 3. This course may perhaps be a survival of a time when this region was tipped toward the north-east, because of the burden of ice which then rested upon Iowa, Minnesota, and eastern Dakota. This is but a conjecture, against which several objections arise, which it is needless to express.

In this connection, it may be helpful to call attention to a similar bend in the Arkansas in central Kansas, and to note that in each case the exceptional direction is upon more recent beds near, and parallel to their junction with, the upper Carboniferous. This may be a straw which would indicate that our first surmise may have some truth in it.

Concerning the efficiency of abstraction to change lines of superficial drainage, we may find considerable light from the study of this region. The remark of Professor Davis, that this rarely occurs where formations are nearly horizontal, seems well supported. Such is the slope of the country, and the porosity of the deposits, that the headwaters of the Big Blue rise a little below the level of the Platte adjacent, and the tributaries of Salt Creek rise below the level of the Big Blue near by, so that it is possible that water may leave the Platte between Kearney and Columbus, pass into the Blue, be drawn off into Salt Creek, and return to the Platte through the latter stream. And yet I know of no clear case of change of channel by abstraction in the whole region. The abundant sand, through the water flows underground, renders an open channel unnecessary. In fact, it may be argued that abundant sand tends to prevent the formation of superficial streams, unless there be first a velocity of flow sufficient to carry the sand easily, which cannot occur unless the flow is concentrated in some way. This is frequently noted in the sunken rivers of deserts. Possibly this may have had something to do with the exceptional course of the Platte before considered. Dunes form an important part of the divide between the Platte and the Little Blue south of Kearney.

One word further, regarding the comparative slopes of the Loup and Platte, to which Professor Hicks has called attention. Do we not find here examples of the law that declivity varies inversely as the quantity of water, as pointed out by Gilbert in his masterly paper on "Land Sculpture," in his report on the Henry Mountains? Although the Platte is much the more important river, by the time it has reached Kearney it is much reduced by evaporation and abstraction; then, because of its shutting off its tributaries by its abundant sediment, as before noticed, it is so reduced that it is often smaller than the Loup at their junction, even sometimes ceasing to flow above the surface, as I have been informed, while the Loup flows with a good current. On the other hand, the Loup is not so much exposed to evaporation, and has numerous tributaries, which having more frequently cut through the sand stratum, and on the lower side of its sloping basin, are more apt to be fed by springs than lose water by seepage.

J. E. TODD.

Tabor, Iowa, Feb. 22.

Estimates of Distance.

BESIDES the very interesting inferences drawn by Mr. Bostwick from his experiment (*Science*, Feb. 26, p. 118), one or two others should be suggested, in the hope that they may lead to some further investigation.

1. Is not an effect of fatigue shown in the eight or ten per cent by which the average observer's "mean deviation" from his own "average" is increased when the last ten of his thirty estimates are compared with the first ten? Should not this effect be greatest,— perhaps both appearing earliest and increasing most rapidly

with the number of observations made, — when the observer is quite untrained; while good previous mental training in things more or less analogous to those tested by the experiment might enable the observer to utilize promptly the practice being got in the experiment itself, and so might for a time overbalance the effect of fatigue? Thus, in the present case, the deviation increased most with the child A. L. B. and one other person, and decreased most with the artist L. F. and one other, but the data are too few to be more than suggestive. It would seem that further experiments upon the relation of fatigue, and of the effective practice got during each experiment, to previous training, etc., might be quite varied in direction and have some educational interest; the best training, *cæteris paribus*, being presumably that which best enables the trained to utilize fresh opportunities for training of a kind somewhat new to him.

2. The probable error of an estimated distance is, of course, some function of the distance and of other data; but *what* function of the distance, when the other data remain, as far as may be, constant? May it not be commonly taken as some low power of the distance whose exponent increases slowly with the distance? In the present case the ratio of the two distances tried is 4.87 : 1; and the average observer's mean deviation in inches from the truth, and from his own average estimate, respectively, are 2.69 and 2.56 times greater for the long distance than for the short; so that the exponent here would not be far from $\frac{2}{3}$.

J. E. OLIVER.

Ithaca, N.Y., March 5.

Work and its Relation to Gaseous Compression and Expansion.

IT is quite well known that the fundamental, and perhaps the most important hypothesis in theoretical meteorology is this, that work is done by air in expanding, and that heat is evolved whenever air is compressed. See "Recent Advances in Meteorology," p. 41. There is a most serious fallacy in this theory, however, in that it ignores the resistance against which the air expands, and considers that the mere diminution of the distance of the molecules of a gas, without the direct expenditure of external energy in changing this distance, can evolve heat.

An illustration will serve to make this clear. Take a cylinder one square foot in area and two feet high with a piston at the top and the air beneath it at atmospheric pressure. Place weights, pound by pound upon the piston, allowing all the heat developed to escape into the outside air. When we have added 2,160 pounds, the air beneath will be compressed to two atmospheres. Fasten the piston and its load, and connect the cylinder with another holding one cubic foot and containing air at normal pressure. An equilibrium will be quickly established and the pressure will be at 1.5 atmospheres in each cylinder. The potential energy remains the same as before; no work has been done and therefore there has been no change in temperature, except a slight chilling and heating due to the rush of the air from one into the other.

Return to the cylinder with the air compressed to two atmospheres and having the same temperature as the outside air. Take off the weight from the piston pound by pound, and the air will gradually expand, and in doing so will lift a weight, thereby doing work which cools the air very greatly, about 50° F. if the initial temperature was 60°. Instead of taking off the weight pound by pound, however, suppose the whole 2,160 pounds had been removed instantly. The only resistance which kept the air compressed has been entirely removed, and it is very evident that the air would expand without doing any work, if we consider that the piston moves back slowly; or, in other words, if we neglect the resistance of the air to the rapid motion of the piston, and hence there would be only a very slight chilling, owing to the work of imparting a certain velocity to the particles rushing out. The same result would have been attained if we had fastened the piston and its load, and then had turned a stop-cock, allowing the air to escape into the atmosphere without making a noise.

I am well aware that the ordinary interpretation of this illustration is very different; for example, Tyndall, in his "Heat as a Mode of Motion," p. 64, in a somewhat similar discussion, says: "The gas, in this experiment, executes work. In expanding it has to overcome the downward pressure of the atmosphere, which amounts to 15 pounds on every square inch, and also the weight on the piston itself. It is just the same as what it would accomplish if the air in the upper part of the cylinder were entirely abolished, and the piston had a weight of 4,320 pounds." I do not see that this changes the aspect of the case at all. Suppose that the air were compressed to two atmospheres beneath the piston, and that that was loaded with 4,320 pounds, while a perfect vacuum existed in the upper part of the cylinder, suppose that we suddenly remove 2,160 pounds from the piston. The piston, still having a load of 2,160 pounds, would fly to the top of the cylinder. How much work has the air done in expanding from two atmospheres to one? None at all. It looks very much as though the compressed air must have lifted that weight, but a little reflection will show that this is not the case. The best way to understand it, perhaps, would be to think of the weight after it reached within .001 of an inch of the top of the cylinder. Here is a weight of 2,160 pounds with the air under it at atmospheric pressure; in one sense the air sustains the weight, but if the air at atmospheric pressure sustains the weight at this point (the top of the cylinder), then the air at the same pressure would have sustained it at the middle of the cylinder. In other words, if we had allowed the compressed air to escape when the piston was at the centre of the cylinder, still with its load of 2,160 pounds and with a perfect vacuum above, there would have been an equilibrium, and we could have pushed the weight up and down, allowing it to stand at any point so long as the outside air had a communication with the lower side of the piston. Does not all this show that the compressed air, considered by itself, did not support any part of the weight at the middle of the cylinder, but was free to expand without lifting any weight or doing any work?

We are strictly taught that the old idea, "nature abhors a vacuum," is not at all tenable; but if we lay aside strict analysis for a moment and resort to this view, I think it will make the situation plainer to us. To all intents and purposes, when our piston loaded with 2,160 pounds had a perfect vacuum above it, we may say that it was sustained by that vacuum, or, at least, that the compressed air had nothing to do in supporting it or in moving it to the top of the vacuum. This seems to be quite an intricate problem, but a little reflection will show that the piston loaded to 2,160 pounds, and having a perfect vacuum above it, with air having free access to its under side, is in precisely the condition it would be in if both ends of the cylinder were open to the air and the piston without weight were located at any point in the cylinder. In this case the piston may be pushed up and down without meeting any resistance except that to the flow of the air.

Consider now the question of heated air rising in the atmosphere. We may simplify the problem slightly by taking a balloon, having an infinitely flexible envelope and without weight. Empty the balloon, and tie the neck so that no air can enter. It would require a pull of 15 pounds to the square inch to separate the sides of the balloon, owing to the pressure of the air. Incredible as it may seem, this is the force which theoretical meteorology has introduced into every discussion of the dynamical heating and cooling of the air, and of the cooling and heating of masses of air as they ascend or descend in the atmosphere, — a force which it is no exaggeration to say is at least 25,000 times as great as that really exerted or developed. Inflate the balloon one-third full with hydrogen gas. The work required to do this is that needed to displace a volume of air equal to the volume of gas which enters the balloon, or it would be that of lifting a weight equal to 1.2 ounces per cubic foot half the height of the balloon. It will probably be said that the outside air helps in this inflation, and I grant that for argument's sake.

Let the neck of the balloon remain open to the outside air, and suppose that the gas can just lift a weight attached to the balloon. The balloon will rise in the atmosphere to a point where the pressure is 10", or until the gas has expanded to fill the whole envelope. Since the work of the balloon is open to the air, the pressure inside will continue exactly the same as that outside. A little reflection will show, however, that the conditions would be

precisely the same whether the neck was opened or closed. The only work the gas would do in expanding would be that which it did in inflating the balloon, or it would simply displace a volume of gas equal to the enlarged volume of the balloon. It is easy to see that this work would be almost inappreciable.

It may help to clearness if we consider two balloons suspended by an endless rope passing over a pulley situated at the extreme height to which the balloon rises. This rope has no weight, and there is no friction at the pulley. One of the balloons is at the earth's surface, and the other at the highest point. The system is in equilibrium, and it would require but the slightest weight at the topmost balloon or a diminution of weight in the balloon at sea-level to disturb the equilibrium and cause the balloons to change places. It is very evident that throughout this motion the air sustains both balloons, and the work of expansion in one balloon or the work done by the air in compressing the gas in the other balloon would be almost inappreciable.

Instead of using hydrogen in our balloons we may use heated air and the results of the analysis would be exactly the same. Lastly, we may dispense with our envelope, and simply consider the heated air as rising in the atmosphere. As we have just seen, this air would do very little work, and the consequent cooling would be very slight; the converse would also be true, that the work of diminishing the distance between the molecules of the gas would be very slight, and the heating almost inappreciable so far as the compression was concerned.

The application of these views, if they shall be sustained, to nearly all theories in meteorology is very obvious. It has been only after the most careful study and analysis of all the questions involved, and a taking up and explaining all the apparent contradictions between the older views and these, that I have felt justified in presenting them so much in detail. I bespeak for them a most searching examination and criticism, hoping that thereby the whole truth may be established.

H. A. HAZEN.

March 2.

Pyrite Incrustations of the Cretaceous Formations of Middlesex County, N.J.

ONE would scarcely expect to find beautiful mineralogical specimens in so uninviting a place as a clay pit. The specimens of pyrite incrusting wood and bark, that may be found in most of the clay pits of Middlesex County, N.J., are very beautiful, whether viewed æsthetically or as cabinet specimens. The incrustations as found near Ford's Corners occur in the black and dark-colored clays which usually overlie the lighter and better clays. This dark stratum of clay contains many remains of leaves, twigs, and bark, which have been partially changed into brown coal. Occasionally whole trunks are found which yield wood which may be wrought into a variety of ornamental objects which are capable of taking a good polish. As waters containing sulphates of iron come in contact with this carbonaceous matter the carbon unites with the oxygen of the sulphates and sulphide of iron is left in its place. In some specimens the pyrite is found covering the carbon, while in others the carbon has been completely replaced by pyrite; at the same time the form of the wood is perfectly retained.

Specimens having the form of twigs not thicker than a lead pencil, and having a fine crystalline surface, are occasionally found. These make very pretty breast-pins when suitably mounted. Some specimens look as though the material of which they were formed had been poured out whilst hot, and had spread on cooling much as hot lead does when poured out on a flat plate. Many specimens occur in the shape of balls as large as hen's eggs. These are made up of concentric layers of scale-like crystals formed about a nucleus at the centre. As these are exposed to the weather they scale off gradually, sometimes remaining bright until the balls disappear completely, while at other times they turn dark immediately.

The pyrite weathers very quickly when left exposed to the action of the air, and the clay waters. If, however, the specimens are collected and washed as soon as they are removed from their native beds, they will remain bright indefinitely.

Specimens are occasionally found weighing four or five pounds. When the pyrite is exposed to the weather in contact with sand or gravel, as the iron is changed to the ferric oxide it cements sand and gravel together so that very often the resulting conglomerate retains the form of the original lump of wood. Your clay-pitter does not look with a favorable eye on the "sulphur balls," as he calls them, for clay containing much sulphide of iron is worthless for brick-making.

Of late years large amounts of clay containing iron have been used for making the so called mottled bricks.

D. T. MARSHALL.

Metuchen, N.J., March 2.

AMONG THE PUBLISHERS.

THE American girl is not slow to grasp a chance. Some time ago *The Ladies' Home Journal* organized a free education system for girls, and the magazine is now educating some forty odd girls at Vassar and Wellesley Colleges, and at the Boston Conservatory of Music, all the expenses of the girls being paid by the *Journal.*

— The March number of *Babyhood* contains an article on "Getting the Teeth — First and Second," by the medical editor, Dr. L. M. Yale, which corrects certain misapprehensions as to the teething process and the troubles which are popularly supposed to accompany it. Similarly helpful medical articles are "The Care of Delicate Children," by Dr. H. D. Chapin, and "Cuts and Scratches," by Dr. H. Power. An alleged "sure cure" for diphtheria is also discussed by a competent writer. Of most general interest, perhaps, is a curious article on "What Shall be Done with Him?" — an account of a completely unmanageable though not at all vicious boy, which is sure to give rise to considerable discussion.

— We have received a copy of the American edition of "Longmans's New School Atlas," the joint work of George G. Chisholm of the Royal Geographical Society and C. H. Leete of the American Geographical Society. It contains thirty-eight double-page maps; but in many cases what is numbered as a single map is really a collection of two or three maps. The introductory maps illustrate the various physical and astronomical phenomena of the globe, the climates and vegetation of different regions and the distribution of races and religions, while the remainder of the book is mainly devoted to political geography. There are, however, several special maps illustrating the climate, geology, and industry of the United States and Canada, and one showing the several acquisitions of territory by the United States. Most of the maps are so colored as to show the elevation of the different sections of land above the level of the sea; which seems to us to be making too much of a very small matter. The selection of maps is very judicious, and the United States does not appear with such overweening importance as it does in most American atlases; though it receives as much attention as the British Empire, and much more than any other part of the world. The number of towns indicated on most of the maps is small; and though a school atlas ought not to be overburdened with town names, the present work would have been better if it had contained more of them. The maps are well engraved on excellent paper, and as a general atlas of the world for school use, the book is meritorious. It is published by Longmans, Green, & Co. of New York, at one dollar and a half.

— Professor David Starr Jordan makes the inspiring influence of a great teacher of science strongly felt in the account of "Agassiz at Penikese," with which he is to open the April *Popular Science Monthly*. The article contains many of Agassiz's own words, which reveal the master's spirit better than pages of description. An authentic account of what treatment the Catholic Church actually gave to Galileo and his discoveries and writings will be given by Dr. Andrew D. White in one of his Warfare of Science papers. Attempts have been made to disprove or explain away much of this ecclesiastical persecution, but Dr. White's statements are fortified by copious citations from authors of unquestioned orthodoxy. The same article tells just how far into

the present century the Catholic Church held to the notion that the earth does not move, and shows that certain Protestant sects displayed much less wisdom by clinging to the antiquated delusion even longer. "Rapid Transit" is the subject of the sixth of Carroll D. Wright's Lessons from the Census. It contains much information concerning operating expenses, relative economy of motive powers, growth of mileage, etc. An interesting study of "Involuntary Movements," by Professor Joseph Jastrow, will appear. Experiments have been made in the psychological laboratory of the University of Wisconsin which show the reality and nature of the motions on which "muscle-reading" depends. Professor Jastrow's article is illustrated with tracings of such movements, and with a figure of the simple apparatus employed in taking them. "The Great Earthquake of Port Royal," which took place in 1692, will be described by Colonel A. B. Ellis. This account corrects certain erroneous notions of the occurrence that have long prevailed, and shows that the arrangement of the present town invites a repetition of the catastrophe. The article is illustrated. The last of the articles on musical instruments in the series on the Development of American Industries will be published in the April number. It is by Daniel Spillane, and traces the evolution of the manufacture of "Orchestral Musical Instruments" in America. The article is fully illustrated.

— Charles Scribner's Sons will publish at once Edward Whymper's long-expected book, "Travels Amongst the Great Andes of the Equator," which was announced last fall, but which they were unable to issue at that time. They have in press a new "Handbook of Great Archæology" (profusely illustrated), dealing with vases, bronzes, gems, painting, sculpture, and architecture, by A. S. Murray, keeper of Greek and Roman antiquities, British Museum. After a long delay Baedeker's "Upper Egypt" has at last been published in English, and is imported by Charles Scribner's Sons. It will be welcomed by all interested in that subject, whether travellers or students.

— Houghton, Mifflin, & Co. have published a book by the theosophist, Mr. A. P. Sinnett, on "The Rationale of Mesmerism." Mr. Sinnett is the author of "Esoteric Buddhism" and other works on theosophy, and in the present volume he professes to account for the phenomena of mesmerism, or hypnotism, on the principles of so-called occultism. He begins by rebuking the physicians and other scientific men for their refusal until very lately to study the phenomena in question or even to admit their existence; and it must be admitted that the rebuke is well deserved. The theories he advances to explain the phenomena are, however, of a very unscientific character. He asserts the existence of a magnetic fluid and also of a third principle in the nature of man, intermediate between the soul and the body, which he calls the "astral" principle; and it is by these imaginary agencies that he attempts to account for mesmerism, He tells us that there is an astral body, which "is quite visible when detached

CALENDAR OF SOCIETIES.

Biological Society, Washington.

March 5.—Fred V. Coville, Conditions affecting the Distribution of Plants in North America; Charles Hallock, The Physiology of a Popcorn; Vernon Bailey, The Homes of Our Mammals; Theo. Holm, The Flora of Nova Zembla.

Entomological Society, Washington.

March 3.—C. W. Stiles, The Histology of Ticks; T. N. Gill, The Larval Condition of Insects an Intercalated Stage.

Appalachian Mountain Club, Boston.

March 9.—Isaac Y. Chubbuck, Up North Tripyramid on Snow Shoes; Percival Lowell, An Ascent of Fuji.

Publications received at Editor's Office.

ARMSTRONG & NORTON. Laboratory Manual of Chemistry. New York, American Book Co. 8°. 144 p. 50 cents.
BLAIR, J. A. The Organic Analysis of Potable Drinking Waters. Philadelphia, P. Blakiston, Son & Co. 12°. 120 p.
BOWSER, EDWARD A. Academic Algebra. Boston, D. C. Heath & Co. 12°. 368 p. $1.25.
CHISHOLM AND LEETE. Longmans' New School Atlas. New York, Longmans, Green & Co. Imp. 8°. 38 Maps. $1.50.
CORNELL UNIVERSITY. Fourth Annual Report of Agricultural Experiment Station, 1891. Ithaca, The University. 8°. 469 p.
DORSEY, JAMES O. Omaha and Ponka Letters. Washington, Government. 8°. Paper. 127 p.
KARRER FELIX. Führer durch die Baumaterial-Sammlungdes k. k. naturhistorischar Hofmuseums in Wien. Wien, Eigenthum des Herausgebers. 12°. Paper. 235 p.
ORTON, EDWARD. Report on the Occurrence of Petroleum, Natural Gas and Asphalt Rock in Western Kentucky. Frankfort, Geological Survey. 8°. 233 p.
RUSSELL, STUART A. Electric Light Cables. London, Whittaker & Co. 12°. 382 p. Ill. $2.25.
SINNETT, A. P. The Rationale of Mesmerism. Boston, Houghton, Mifflin & Co. 16°. 232 p. $1.25.
TAYLOR, J. TRAILL. The Optics of Photography and Photographic Lenses. New York, Macmillan & Co. 16°. 234 p. $1.
THOMAS, CYRUS. Catalogue of Prehistoric Works East of the Rocky Mountains. Washington, Government. 8°. Paper. 246 p.
UNIVERSITY OF CALIFORNIA. Riverside Addresses, 1891. Berkely, The University. 16°. Paper. 74 p.
VERITY, JOHN B. Electricity up to Date. New York, Frederick Warne & Co. 16°. Paper. 176 p. 75 cents.
WINSLOW, ARTHUR. Report on the Coal Deposits of Missouri. Jefferson City, The Geological Survey. 8°. 226 p.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For exchange.—A fine thirteen-keyed flute in leather covered case, for a photograph camera suitable for making lantern slides. Flute cost $27, and is nearly new. U. O. COX, Mankato, Minn.

To exchange; Experiment Station bulletins and reports for bulletins and reports not in my file. I will send list of what I have for exchange. P. H. ROLFS, Lake City, Florida.

Finished specimens of all colors of Vermont marble for fine fossils or crystals. Will be given only for valuable specimens because of the cost of polishing. GEO. W. PERRY, State Geologist, Rutland, Vt.

For exchange.—Three copies of "American State Papers Bearing on Sunday Legislation," 1891, $2.50, new and unused, for "The Sabbath," by Harmon Kingsbury, 1840; "The Sabbath," by A. A. Phelps, 1842; "History of the Institution of the Sabbath Day, Its Uses and Abuses," by W. L. Fisher, 1859; "Humorous Phases of the Law," by Irving Browne; or other works amounting to value of books exchanged, on the question of governmental legislation in reference to religion, personal liberty, etc. If preferred, I will sell "American State Papers," and buy other books on the subject. WILLIAM ADDISON BLAKELY, Chicago, Ill.

Wanted, in exchange for the following works, any standard works on Surgery and on Diseases of Children: Wilson's "American Ornithology," 3 vols.; Coues' "Birds of the Northwest" and "Birds of the Colorado Valley," 2 vols.; Minot's "Land and Game Birds of New England;" Samuels' "Our Northern and Eastern Birds;" all the Reports on the Birds of the Pacific R. R. Survey, bound in 2 vols., morocco; and a complete set of the Reports of the Arkansas Geological Survey. Please give editions and dates in corresponding. R. ELLSWORTH CALL, High School, Des Moines, Iowa.

For sale or exchange, LeConte, "Geology;" Quain, "Anatomy," 2 vols; Foster, "Physiology," Eng. edition; Shepard, Appleton, Elliott, and Stern, "Chemistry;" Jordan, "Manual of Vertebrates;" "International Scientists' Directory;" Vol. I. *Journal of Morphology;* Balfour, "Embryology," 2 vols.; Leidy, "Rhizopods;" *Science*, 18 vols., unbound. C. T. McCLINTOCK, Lexington, Ky.

To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g to 1-10mg), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862–1885 (62–71 bound); Smithsonian Reports, 1854–1883; U. S. Coast Survey, 1854–1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

from the physical body to those who are gifted in any high degree with clairvoyant vision," and that "the astral plane affords direct communion between the consciousness of the operator and the subject when the two are brought into true magnetic harmony." This explanation, as our readers will see, is no explanation at all; yet it is not a whit worse than the theory of "multiple personality" which is advocated by many French and German hypnotists. In our opinion the phenomena in question are far too intricate to be accounted for by any principles now known to us, and we believe that much more investigation and far deeper thinking are necessary before the true explanation can be given.

— The Cassell Publishing Company announce the "Record of Scientific Progress for the year 1891," exhibiting the most important discoveries and improvements in all the branches of engineering, architecture and building, mining and metallurgy, the mechanic arts, industrial technology, and the useful arts, photography, chemistry, medicine and surgery, printing, the generation, measurement, transmission, and application of electricity, the telegraph and telephone, meteorology and aeronauty, astronomy, etc. The editor is Professor Robert Grimshaw.

— M. Camille Flammarion, the author of "Uranie," is too well known to need more than the announcement of a new volume from his pen to attract readers. His new story, "Lumen," announced by the Cassell Publishing Company, is very much in the manner of "Uranie," a scientific romance. "It is a delightful thing in these prosaic days," says a well-known critic, "to get away from the novels of realism and strike out into something of an entirely different order that lifts one into the clouds — the pun is unintentional — and takes him away from the earth. It is just this that M. Flammarion does and it is a rest to the weary brain to read his graceful stories." Mrs. Serrano, who translated "Uranie," has translated this volume.